REMARKS

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow. This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier.

After amending the claims as set forth above, claims 1-5, 7-11, 13 and 16-28 are now pending in this application. Claim 13 was amended to depend from claim 5 to overcome the objection to claim 13. No new matter was added.

I. The prior art rejections should be withdrawn

Independent claim 20 was rejected under § 103(a) as being unpatentable over Watari (USP No. 5,922,145), Shibata (USP No. 4,773,947) or Eguchi (USP No. 5,746,842) in view of the ASM Handbook, Volume 4, Heat Treatment, Annealing of Steel chapter ("Annealing of Steel Textbook"). Independent claims 1, 4, 5 and 7 were rejected under § 103(a) as being unpatentable over Eguchi in view of the Annealing of Steel Textbook. Dependent claims were rejected under § 103(a) over Eguchi and Annealing of Steel Textbook alone or further in view of additional references. These rejections are respectfully traversed.

1. No motivation to combine

The Office Action asserts that the spheroidizing heat treatment is disclosed in the Annealing of Steel Textbook. However, there is no motivation to use the high carbon steel spheroidizing heat treatment of the Textbook in a low carbon steel of Eguchi.

The Annealing of Steel Textbook discloses on page 47, middle column, that "Low-carbon steels are seldom spheroidized for machining, because in the spheroidized condition they are excessively soft and "gummy," cutting with long, tough chips." This passage means that spheroidizing heat treatment (annealing) is seldom applied to a low carbon steel in order to obtain a good machinability.

The present inventors unexpectedly discovered that the claimed spheroidizing heat treatment (annealing), when applied to a low carbon steel, results in a high turning-machinability. Thus, applying the spheroidizing heat treatment to low carbon steel for the purpose of improving the machinability cannot be derived from the Annealing of Steel Textbook because the Textbook teaches away from this combination. Therefore, there is no motivation to combine Eguchi and the Annealing of Steel Textbook. In addition, with respect to claim 20, there is no motivation to combine Watari or Shibata and the Annealing of Steel Textbook.

2. Rebuttal of the reasoning in the Office Action

Page 9, lines 5-8 of the Office Action as well as page 5, lines 11 to 14 and page 7, lines 7 to 10 of the Office Action state that "when the alloy content, such as Cr and Mo, was increased as it is in the alloy of Eguchi et al. [or Watari or Shibata] compared to the prior art 9840 alloy, one of ordinary skill in the art would have expected the ability of the low-carbon steels to be machined after spheroidizing to have increased because of the increased hardness."

Thus, the issue is raised in the Office Action is whether or not one of ordinary skill in the art would have expected an improved ability of the low-carbon steels to be machined after spheroidizing because of the increased hardness due to the higher alloy content. However, as is explained in more detail below, there is no evidence in the actual data in the Annealing of Steel Textbook that one of ordinary skill in the art would have expected an improvement in the properties of low carbon, high alloy content steel from the spheroidizing treatment, due to the high alloy (such as Cr and Mo) content. Thus, one of ordinary skill in the art would not be motivated by the Annealing of Steel Textbook to spheroidize a low carbon steel of Eguchi even if the steel contains a high Cr and Mo content.

Applicants have summarized in Table A, below, steel compositions, hardness, and indication of whether the spheroidizing treatment is performed or not known from Table 4 of the Annealing of Steel Textbook. In other words, in Table A, the last column "indication of spheroidizing treatment" shows whether a spheroidizing treatment is performed on a

particular steel in Table 4 of the Annealing of Steel Textbook (indicated by a particular temperature profile in Table 4) or is not performed on a particular steel in Table 4 of the Annealing of Steel Textbook (indicated by the "..." symbol in Table 4).

Table A

Steel (material)	C (%)	Mn (%)	Cr (%)	Ni (%)	Mo (%)	Hardness (HB)	Indication of spheroidizing treatment
4320	0.20	0.55	0.50	1.80	0.25	197	None
4340	0.40	0.70	0.80	1.80	0.25	223	Present
4620	0.20	0.55	-	1.80	0.25	187	None
5120	0.20	0.80	0.80	-	-	179	None
5140	0.40	0.80	0.80	-	-	187	Present
8620	0.20	0.80	0.50	0.55	0.20	187	None
8640	0.40	0.85	0.50	0.55	0.20	197	Present
1320	0.20	1.75	-	-	-	170	None
1340	0.40	1.75	-	-	-	174	Present
9840	0.40	0.80	0.80	1.00	0.25	192	Present

As shown in Table A and as provided in Table 4 of the Annealing of Steel Textbook, even though the alloy content (such as Cr and Mo) is increased to raise the hardness of steel for some alloys, the spheroidizing treatment condition is still not indicated for these alloys.

For example, steel 4620 has a low Cr and Mo content (0% Cr and 0.25% Mo). This steel is not subjected to a spheroidizing heat treatment. Steel 4320 has a higher Cr and Mo content (0.5% Cr and 0.25% Mo). However, despite the higher alloy content and higher hardness, the 4320 steel is not subjected to the spheroidizing heat treatment either. In another example, steel 5120 has a lower total Cr, Ni and Mo content (0.8% Cr, 0% Ni and 0% Mo) than the 8620 steel (0.5% Cr, 0.55% Ni and 0.2% Mo). However, neither steel is subjected to a spheroidizing heat treatment.

Thus, one of ordinary skill in the art would not have associated the higher alloy content and higher hardness with the ability of the low-carbon steels to be machined after spheroidizing or with the ability of the spheroidizing heat treatment to have a positive effect on the properties of these low-carbon steels.

In contrast, Table A shows that the spheroidizing heat treatment is provided for all steels having a high carbon content (i.e., 0.4% C), but is not provided for any steels having a low carbon content (i.e., 0.2% C). In other words, the spheroidizing heat treatment is performed in Table A only on the higher carbon steels having 0.4% C.

As a result, one of ordinary skill in the art would have expected only that the gummy steel can be changed by increasing the carbon content of the steel to 0.4%, thereby making spheroidizing possible. However, from the data in Table A, one of ordinary skill in the art would not have expected that the gummy steel can be changed by increasing Cr and Mo in the low carbon steel to make spheroidizing possible. Additionally, as is apparent from the comparison in hardness between the materials 1320 and 4320, there is no equivocal relationship between hardness increase and the spheroidizing treatment.

Therefore, even though Eguchi (or Shibata and Watari with respect to claim 20) has a higher Cr and Mo content than the 9840 steel in Table 4 of the Annealing of Steel Textbook, one of ordinary skill in the art would not have expected that the higher Cr and Mo content of Eguchi (or Shibata or Watari) would allow the spheroidizing heat treatment to have a positive effect on the properties of the low carbon steel of Eguchi.

In other words, the Annealing of Steel Textbook does not provide motivation or suggestion to make the spheroidizing possible by increasing only the Cr and Mo alloy content to raise the hardness, as suggested in the Office Action. Particularly, there is no motivation to make the spheroidizing possible by increasing Cr and Mo content over that of the 9840 Steel. From the disclosure of Annealing of Steel Textbook, one of ordinary skill in the art would have known that the 9840 steel can be spheroidized owing to the fact that it has a high (0.4%) carbon content.

The Office Action points to the first sentence in column 3 on page 47 of the Annealing of Steel Textbook as implying that increasing the alloy content alone results in higher as-spheroidized hardness. However, this statement is apparently not supported by the data in Table 4 on the same page of the Textbook.

3. The combination does not teach or suggest all claimed elements

Furthermore, even if there was motivation to combine Eguchi and the Textbook, the combination would not teach or suggest all claimed limitations. The independent claims of the present application recite that the spheroidizing anneal is conducted at 700 to 820 C followed by the claimed cooling parameters.

In contrast, the middle paragraph on page 47 of the Annealing of Steel Textbook states that 1020 steel may be spheroidized at 690 C after being cold drawn into a tubing. This page does not describe the cooling schedule. These parameters are different from those of the independent claims of the present application.

There is no other disclosure of the spheroidizing parameters for low carbon steels in the cited portion of the Textbook. Table 4 of the Annealing of Steel Textbook does not disclose the spheroidizing condition of low carbon steels. Thus, this Textbook does not suggest to conduct the spheroidizing anneal for a low carbon steel at 700 to 820 C followed by the claimed cooling parameters, as recited in the independent claims.

The Office Action relies on the spheroidizing conditions of the high carbon 9840 steel. Applicants submit that the heat treatment conditions for high carbon steels, such as the 9840 steel containing 0.4% carbon, are not necessarily the same as those for low carbon steels. For example, on page 46, second column, fourth full paragraph of the Annealing of Steel Textbook, the spheroidizing process for a 1040 steel (a medium/high carbon steel containing about 0.37 to 0.44 % carbon) is explained as follows: "Cooling at a suitable rate from the minimum temperature at which all carbide is dissolved to prevent reformation of a carbide network, ... " This means that the purpose of annealing for medium and high carbon steel is to prevent once separated carbide (cementite) from reforming carbide network.

In contrast, the present inventors discovered that in the low carbon machine structural steel, a carbide precipitates under a heat treatment for spheroidizing. This limitation that a carbide is precipitated is recited in all pending independent claims. The purpose of the spheroidizing heat treatment in the claimed invention is to precipitate carbides, such as MC, M_2C, M_7C_3 and the like, in addition to prevention of formation of carbide network.

Therefore, the spheroidizing heat treatment in the claimed invention is different in principle and purpose from the annealing of the medium and high carbon steel described in Annealing of Steel Textbook.

One or ordinary skill in the art would not necessarily use the spheroidizing parameters for high carbon steels, such as 1040 or 9480 steel, used to prevent reformation of a carbide network, to precipitate carbides in a low carbon steel, such as the steel of Eguchi. Thus, these parameters are not a matter of routine optimization.

II. The § 112 rejections should be withdrawn

Independent claim 20 was rejected under § 112, ¶1, as being not enabled for the claimed silicon range, and under § 112, ¶2, as being indefinite for containing the term "relatively small amount." These rejections are respectfully traversed.

Claim 20 recites a relatively small amount of silicon not less than 0.4 wt %. As explained in the previous response, this claimed amount is commensurate in scope with the examples provided in the specification. Thus, this term is limited to a few percent silicon, such as 0.4 to 2% silicon, for example, but below 4% silicon suggested in the Office Action. Applicants submit that the specification enables the claimed silicon range because this claimed range is commensurate in scope with the present specification.

Furthermore, applicants submit that the term "relatively small amount" complies with § 112, ¶2, because one of ordinary skill on the art can ascertain the metes and bounds of this range. As discussed in the previous responses, persons of ordinary skill in the art can recognize the effective amount of silicon that can be used in a steel to achieve desired results based on reading the present specification and the prior art. For example, the specific examples of the present specification illustrate that 1.23 wt.% silicon is a "relatively small amount." However, the upper range of silicon may also be a fraction of a percent higher depending on the other alloying elements in the steel, such as for example up to 2.0% silicon. One of ordinary skill in the art can easily determine this range without undue experimentation.

In response to the question on page 14 of the Office Action, claim 20 includes silicon content of 2.0% or less, such as 1.5 and 2.0% mentioned in the Office Action.

III. Conclusion

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

Date 10/1/04 By _____

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The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.